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Edexcel GCE

Biology
Advanced
Unit 5: Energy, Exercise and Coordination

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| Thursday 27 January 2011 – Morning Time: 1 hour 45 minutes | Paper Reference 6BI05/01 |
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| You must have: A copy of the scientific article taken from New Scientist articles (enclosed) | Total Marks |
|--|-------------|

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
– *there may be more space than you need.*

Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets
– *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
– *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*

Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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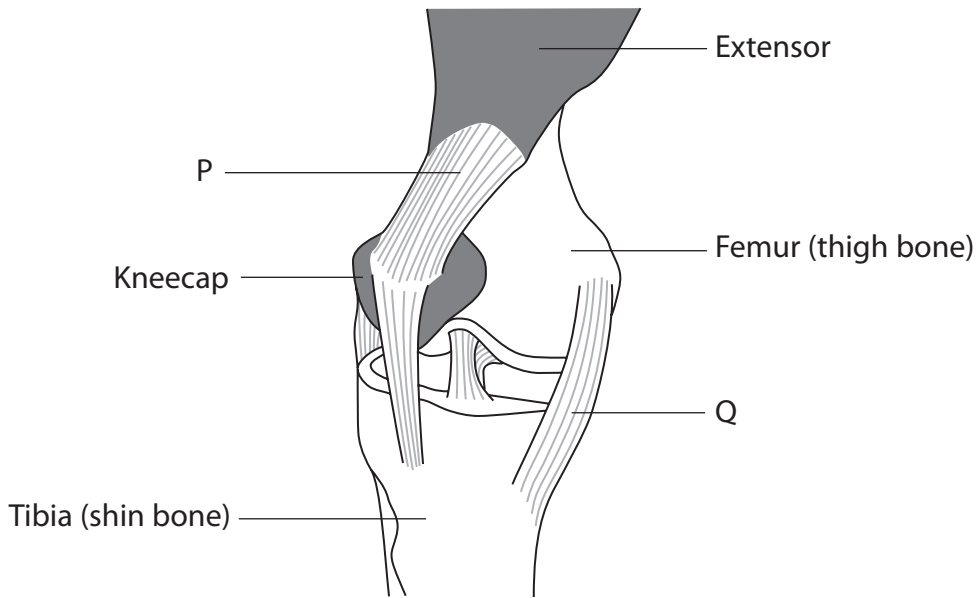
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Answer ALL questions.

Some questions must be answered with a cross . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

- 1** Sports injuries can result in damaged human knee joints. The damaged joint can be repaired using keyhole surgery.

The diagram below shows a human knee joint.



(a) Place a cross in the box to identify each of the following structures.

(i) Structure P

(1)

- A** Cartilage
- B** Ligament
- C** Muscle
- D** Tendon

(ii) Structure Q

(1)

- A** Cartilage
- B** Ligament
- C** Muscle
- D** Tendon



(b) Describe the function of structure Q.

(2)

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(c) Structure Q may become torn during some sporting activities. It may not be possible to join the torn parts together. Material can be removed from structure P without causing any damage. This material can be used to join the damaged pieces of Q together.

Suggest why the use of material from structure P will mean that recovery will be quite slow and require careful physiotherapy.

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(d) The operation to repair the damage can be done using keyhole surgery.
Suggest the benefits of this technique.

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(Total for Question 1 = 9 marks)



2 Plants can detect and respond to environmental cues.

Cocklebur is a plant that flowers after it has been exposed to a sufficiently long period of darkness. The minimum length of time in darkness needed to stimulate flowering is called the critical period.

An investigation was carried out into the effect of light and dark periods on cocklebur flowering. Four plants, A, B, C and D, were exposed to light and dark periods of different length. The presence or absence of flowers was recorded after several weeks.

The diagram below shows the pattern of light and dark periods for these plants and the effect on flowering.

| Plant | Time / hours | | | | | | Flowers present |
|-------|--------------|---|---|----|----|----|-----------------|
| | 0 | 4 | 8 | 12 | 16 | 20 | |
| A | | | | | | | Yes |
| B | | | | | | | No |
| C | | | | | | | No |
| D | | | | | | | No |

key

Light
 Dark

(a) (i) Using the information in the diagram, give the critical period for flowering of cocklebur plants.

(1)

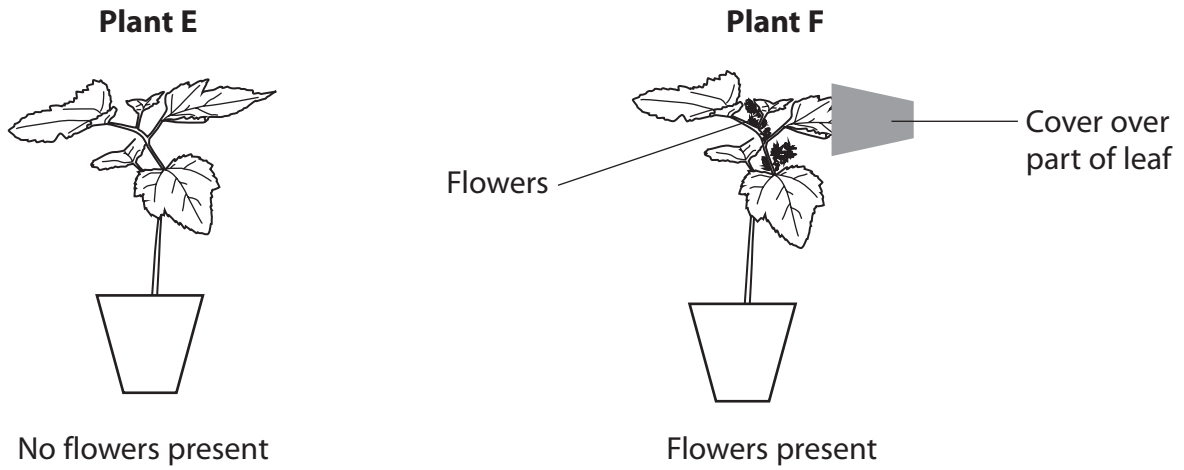
(ii) Using the information in the diagram and your own knowledge of photoreceptors, explain why plant B has not flowered.

(2)



(b) In a further investigation, plants E and F were exposed to six hours of darkness each day. Part of a leaf on plant F was covered so that the leaf experienced eight hours of darkness each day.

The diagram below summarises the results of this investigation.



Explain the purpose of plant E in this investigation.

(2)

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3 L-Dopa can be used to treat people with Parkinson’s disease. Using L-Dopa for a long period of time can have side effects that include uncontrolled movement of limbs.

It is possible that increasing the levels of serotonin in the brain could be an effective treatment for these side effects. It has been suggested that MDMA (ecstasy) could be used to increase levels of serotonin.

(a) Explain why L-Dopa is used to treat people with Parkinson’s disease.

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(b) Explain how MDMA could affect levels of serotonin in the brain.

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(c) In trials of this treatment, marmosets (small monkeys) were given a drug to reduce dopamine production. They were then treated with L-Dopa until they showed the side effects observed in the treatment of people with Parkinson’s disease.

(i) Suggest a reason why the marmosets were treated with a drug to reduce dopamine production.

(1)

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(ii) Describe the ethical issues involved in the use of animals in a trial of this kind.

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(d) The results of the study showed that MDMA did reduce the side effects in the marmosets.

Describe the steps that would need to be taken before a similar treatment could be used in humans.

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(Total for Question 3 = 12 marks)



- 4 According to the sliding filament theory of muscular contraction, force is produced when myosin molecules change shape.

Myosin molecules can generate a force of 1.7×10^{-6} N per million molecules when they change shape.

Measurements of a single muscle fibre showed that a force of 3.5×10^{-3} N was produced when it contracted.

- (a) Use this information to calculate the number of myosin molecules changing shape during the contraction of this muscle fibre. Show your working.

(2)

Answer

- (b) Examination of this muscle fibre found that there were only a few mitochondria present.

- (i) Name this type of muscle fibre.

(1)



(ii) The energy required for contraction of muscle fibres is provided by ATP. Describe how enough ATP is made available for contraction of this muscle fibre, despite there being only a few mitochondria.

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(iii) Explain why you would expect this type of muscle fibre to fatigue quickly.

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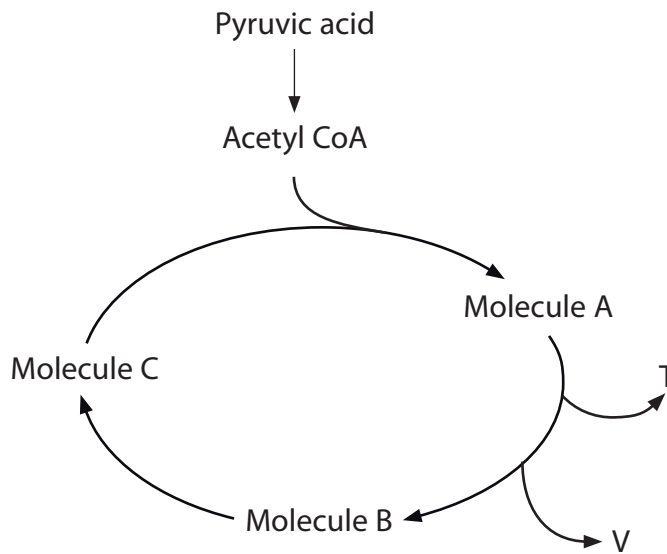
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(Total for Question 4 = 10 marks)



5 The diagram below summarises some of the reactions in aerobic respiration.



(a) Name the process that produces pyruvic acid.

(1)

(b) Place a cross ☒ in the box that correctly identifies each of the following.

(i) The waste product V

(1)

- A ATP
- B Carbon dioxide
- C Lactic acid
- D Water

(ii) The molecule T that becomes reduced during the process

(1)

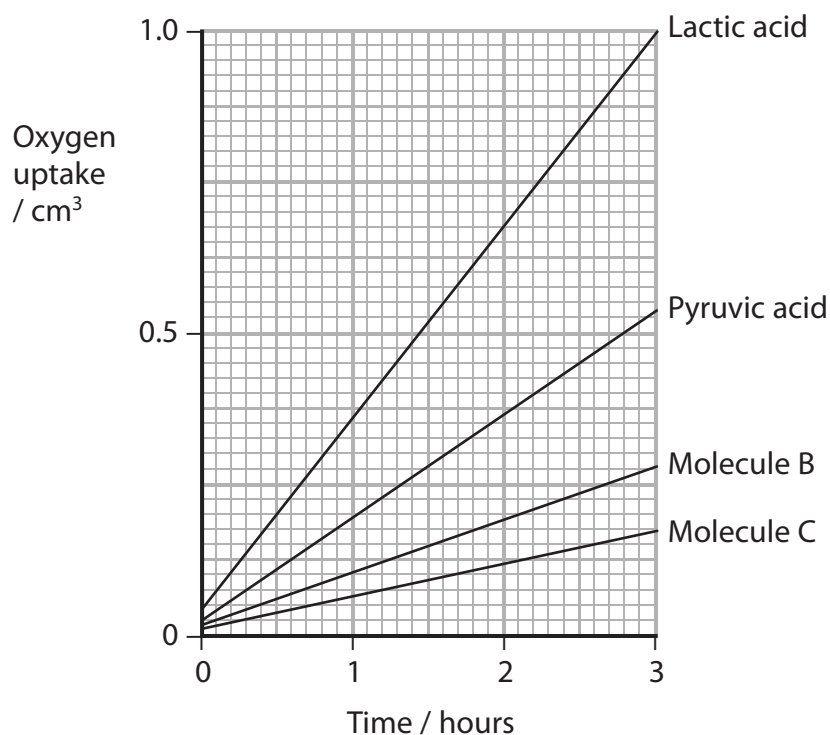
- A ADP
- B Oxygen
- C NAD
- D Water



(c) An investigation was carried out into the ability of bacteria to use different substances as substrates for aerobic respiration.

Cultures of bacteria were grown separately in media containing lactic acid or one of the substances shown in the diagram (pyruvic acid, molecule B or molecule C). The initial concentration of each of these substances in the media was the same. The oxygen uptake of each culture was measured over a period of time.

The results are shown in the graph below.



(i) Using the information in the diagram and the graph, suggest an explanation for the differences in oxygen uptake between bacteria using pyruvic acid, molecule B and molecule C as a substrate.

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(ii) Suggest **one** reason for the rapid oxygen uptake by bacteria in a medium containing lactic acid. Give an explanation for your answer.

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(Total for Question 5 = 9 marks)



6 Cardiac muscle is myogenic.
The rhythmic contraction of the heart, in a particular sequence, is a feature of the cardiac cycle.

(a) Explain what is meant by the term **myogenic**.

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*(b) Describe how the sequence of muscular contraction in the heart is coordinated and how the movement of blood through the heart is controlled.

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(Total for Question 6 = 8 marks)



7 The scientific article you have studied is adapted from articles in New Scientist. Use the information from the article and your own knowledge to answer the following questions.

(a) Name one 'retinal photoreceptor protein' (second paragraph on page 2) and describe its function.

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(b) Explain what is meant by 'The human genome project could help to change that' (fourth paragraph on page 2).

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(c) Suggest why genes are only partly responsible for the development of cancer and heart disease.

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(d) Attempts to treat cystic fibrosis with gene therapy have not yet been successful.

Use information in the article to suggest reasons why inserting the correct gene into a cell may not be all that is required.

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*(e) Explain how RNA templates are used to specify the chemical structure of a protein.

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(f) Explain how a transcription factor might 'recognise a particular stretch of DNA' (first paragraph on page 4).

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(g) Use the information in the article to describe ways in which new genes can arise.

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(h) Explain how NF-k B might have a role in the development of atherosclerosis.

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(i) Explain why a DNA strand is not read 'in six different ways' (eighth paragraph on page 8).

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(j) About 10 million years ago, an event led to the production of antifreeze protein in one Antarctic fish. Explain why almost all Antarctic fish now contain antifreeze protein.

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(Total for Question 7 = 30 marks)

TOTAL FOR PAPER = 90 MARKS



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